

REMARKS

Claims 35-51 are now pending in the application. Claims 52-57 and 59 are cancelled herein. Claims 58 and 60-61 are withdrawn herein. Claims 38, 47 and 62-63 are amended herein. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

ELECTION/RESTRICTIONS

Applicant appreciates the Examiner's reconsideration and withdrawal of the restriction/election requirement. Claims 58 and 60-61 have been withdrawn, and claim 59 has been cancelled.

REJECTION UNDER 35 U.S.C. § 112

Claims 38, 47, 59, 62, and 63 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point and distinctly claim the subject matter which Applicant regards as the invention. This rejection is respectfully traversed.

The Examiner has rejected to claims 38, 47, 59, 62 and 63 as being indefinite. Claims 38 and 63 have been amended to recite a range for each of the components within the MS-51 formulation and so none of the amounts read on 0%. Claim 47 has been amended to recite that it depends from claim 35 and not claim 1. Claim 59 has been cancelled rendering the rejection moot. Claim 62 has been amended to replace the term "closed solvent environment" with "curing chamber." In light of the amendments the Applicant considers the rejections relating to indefiniteness have been overcome.

REJECTION UNDER 35 U.S.C. § 102/103

Claims 52-57 and 59 stand rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Floch et al. (U.S. Patent No. 5,698,266). Claims 52-57 and 59 have been cancelled without prejudice.

REJECTION UNDER 35 U.S.C. § 103

Claims 35-37, 42-51 and 62 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Floch et al. (U.S. Patent No. 5,698,266). This rejection is respectfully traversed.

Current claim 35 recites the steps of (i) producing a silica precursor formulation by adding silicic acid tetramethyl ester homopolymer to a solvent; (ii) coating a substrate with the silica precursor formulation; and (iii) curing the silica precursor formulation onto the substrate in a vaporous ammoniacal environment. Current claim 62 recites similar and additional steps.

Floch discloses a slight modification to traditional sol-gel techniques for producing thin films of optical quality using silica colloids. The process taught by Floch is to produce a fully hydrolysed silica colloid in alcohol which is then applied to a substrate. To be effective, the substrate must be meticulously clean, for example with hydrofluoric acid and detergent solution treatments, to be useful in this process. The coating is then allowed to dry before being subjected to an alkaline treatment. This is said to result in silica films which have improved abrasion resistance properties.

In particular, Floch discloses the use of a colloidal suspension of a silicon oxide, such as tetraethyl orthosilicate, dispersed in an aliphatic alcohol solution to coat a

plastic or glass substrate which is subsequently exposed to a liquid or gaseous alkaline treatment to provide an optical coating which is resistant to abrasion, as discussed.

The Examiner, by reference to column 4 lines 10-60, alleges that Floch discloses the formation of a precursor solution comprising silicic acid tetramethyl ester homopolymer, similar to that of Applicant's claim 35. The Applicant respectfully disagrees and believes this is due to a misunderstanding in the nomenclature of silicate monomers and polymers.

At Column 4, lines 19-29, and in examples 1 and 2 of Floch teaches the use of distilled tetraethyl orthosilicate (TEOS) which has the chemical formula $\text{Si}(\text{OC}_2\text{H}_5)_4$. In other words this compound is a monomer comprising a central silicon atom with four ethoxy groups attached. Tetramethyl orthosilicate (TMOS), also mentioned in Floch, is the methyl analogue of the TEOS monomer. Alternative names for tetramethyl orthosilicate include tetramethoxysilane, silicic acid tetramethyl ester and silicon methoxide. It should be understood that these all refer to **monomers of the formula $\text{Si}(\text{OCH}_3)_4$** . The formula $\text{M}(\text{OR})_n$ recited in the same passage of Floch is also indicative of monomeric sources.

The Applicant's claim 35, however, refers to a silicic acid tetramethyl ester **homopolymer**. As the Examiner will be aware, a polymer is a macromolecule made up of repeating structural units (monomers) and polymers that contain only a single type of monomer are known as homopolymers. The molecular formula of silicic acid tetramethyl ester homopolymer would be known to one skilled in the art and can be adequately represented by $\text{CH}_3\text{O}[\text{SiO}(\text{OCH}_3)_2]_n\text{CH}_3$. Typically, for the commercially available product, $n=4$. It should now be clear that the tetraethyl orthosilicate (TEOS)/ tetramethyl

orthosilicate (TMOS) disclosed in Floch are quite different chemical entities to Applicant's silicic acid tetramethyl ester homopolymer. The table below describes various properties of TMOS and silicic acid tetramethyl ester homopolymer (sold as methyl silicate 51 or MS-51), to further reinforce the differences.

Items	unit	Tetramethyl orthosilicate (monomer)	Methyl silicate 51 (average tetramer)
Molecular Formula	-	$\text{Si}(\text{OCH}_3)_4$	$\text{CH}_3\text{O}[\text{Si}(\text{OCH}_3)_2\text{O}]\text{CH}_3$
Molecular Weight	-	152.2	470.7
Specific Gravity (25°C)	-	1.03	1.18
Viscosity (25°C)	mPaS	0.6	5
Appearance	-	Colorless transparent	Colorless transparent
Color (APHA)	-	Below 10	Below 20
Silica content	%	39	51
Purity (by GC)	%	99.5 or more	(oligomer mixture)
Alkaline Metals Impurities	ppb	Below 100	Below 100
Heavy Metals Impurities	ppb	Below 100	Below 100

This table is reproduced from the Fuso website (<http://www.fusokk.co.jp/eng/product/elec/004.html>, see attached), a Japanese supplier of MS-51. Fuso's product description also states that "Methyl silicate 51' [is] prepared by condensing tetramethyl orthosilicate to oligomerize it into the average tetramer" Again, this makes it clear that the silicic acid tetramethyl ester homopolymer, as recited in Applicant's claim 35, is a homopolymer, and is a different entity with different physical and chemical properties to those of TMOS disclosed in Floch.

For the sake of completeness Applicant also includes the below table comparing various properties of TEOS, referred to by the Examiner, and silicic acid tetramethyl ester homopolymer.

Parameter	TEOS	MS-51
Formula	$C_8H_2OO_4Si$	$CH_3O[SiO(OCH_3)_2]_nCH_3$
Molecular weight	208.2	470.7
Flash point	37°C	112°C
Specific gravity	0.94	1.18
Viscosity	1.79 cP	4.7 cP

The use of silicic acid tetramethyl ester homopolymer therefore represents a very significant departure from the teaching of Floch and results in there being considerable differences in the Applicant's method of producing silica films and of the structure and characteristics of films obtained from such a method.

In terms of the process itself, Floch teaches taking a silicon oxide monomer, such as TEOS, mixing it with ethanol and ammonium hydroxide and then waiting for the colloid to form via complete hydrolysis and condensation reactions. For example Floch, at column 6, lines 44-46, and in example 1 states that "the hydrolysis requires a minimum of 48 hours at 25 °C in order to be complete." The resulting silica sol must then be filtered before coating onto the substrate. Floch then teaches a subsequent treatment with ammonia to improve cohesion of the silica particles which are deposited out of the colloid.

The claimed subject matter is different in that hydrolysis of the silicic acid tetramethyl ester homopolymer only occurs after the film has actually been coated on the substrate. This is reflected in Applicant's claim 35 wherein a simple precursor formulation of silicic acid tetramethyl ester homopolymer in a solvent with a water content of no more than 5% by volume is prepared and then directly coated onto a substrate before then exposing it to an ammoniacal environment for curing.

The Applicant's treatment with gaseous ammonia directly brings about the primary hydrolysis and condensation steps on the coated substrate surface without generating a colloid. Applicant also may use alcohol and/or water in the ammoniacal curing environment in order to control the reactions and tune the properties of the final product. Since a colloid is not formed, then a 48 hour minimum reaction time or the like is not required before coating. This process also allows better control over the physical characteristics of the film. This difference is clearly set out at page 5, line 23 to page 6, line 5, of the present specification. This results in a faster, simpler and more controllable method than that disclosed by Floch.

The present process is neither taught nor suggested by Floch. That silicic acid tetramethyl ester homopolymer could be used in such a manner as set out in the Applicant's claim 35 to produce mesoporous silica films is in no way taught or suggested by the disclosure of Floch. As previously discussed, due to the different properties of the starting precursor solutions the methods of the Applicant and Floch are entirely separate and distinct. The Applicant therefore submits that claims 35 and 62 and all claims dependent thereon are patentable over the teaching of Floch.

Finally, the Examiner has objected to claims 38-41 and 63 as allegedly being obvious over the disclosure of Floch in view of Nambu *et al.* (US 6,316,572). The Examiner asserts that "Nambu *et al.* (US'572) teach similar steps of adding MS-51 from ColCote, which apparently contains the recited components, to a solvent which may contain water and alcohol to obtain a coating with good weather resistance and appearance" and contends it would have been obvious to a person of ordinary skill in the art to modify the process of Nambu *et al.* by using MS-51 from ColCote as the

source of the silicic acid tertamethyl ester homopolymer and tetramethoxysilane to make the sol gel taught by Floch, because Nambu *et al.* teaches that MS-51 is useful to form a curable silicate film of good appearance and weather resistance without the need for a levelling agent.

In light of the above discussion regarding Floch and the claim amendments presented, Applicant submits that claims 35 and 62 are patentable over the disclosure of Floch. Applying the same reasoning, claims 38-41 and 63 are patentable of Floch in combination with Nambu *et al.* However, the disclosure of Nambu will be briefly addressed for the sake of completeness.

Nambu *et al.* disclose a multi-component composition for producing coatings with good weather resistance and appearance. The composition contains three essential components: A – a resin with epoxy and carboxyl moieties; B – a vinyl copolymer which contains at least one hydrolysable silyl group; and C – a silicon compound containing hydrolysable groups which is included to improve stain resistance. The multi-component system also contains a 4th set of compounds, namely D – a curing catalyst.

The Examiner asserts that Nambu *et al.* teaches that MS-51 is useful to form a curable silicate film of good appearance and weather resistance without the need for a levelling agent. This statement is only true in the context of the multi-component composition detailed in Nambu *et al.*, and is not a generic fact associated with MS-51 compositions or indeed the other silane/siloxane compounds listed. There is no teaching or suggestion to one skilled in the art that MS-51, as it is employed in Nambu *et al.*, would likely be a useful silica source for the process of Floch. Further, simply because MS-51 was useful in the process of Nambu *et al.* (which is entirely different

from that of Floch) does not mean that there would be the requisite reasonable expectation of success that it would be suitable to modify the process of Floch which only discusses the use of monomeric silica sources. Thus, there is no teaching or motivation for one skilled in the art to change the source to a homopolymer.

Furthermore, Nambu *et al.* do not "teach similar steps of adding MS-51 from ColCote which apparently contains the recited components, to a solvent which may contain water and alcohol to obtain a coating with good weather resistance and appearance." The cited passage in fact refers to the process by which you can take a precursor of MS-51 (for example tetraalkylsilicates, etc.) and partially hydrolyse and condense them in water "in the conventional manner" or indeed take the precursor in alcoholic solvent and add water and acid to make partial hydrozylate condensates.

For all of the foregoing reasons, the Applicant respectfully submits that independent claims 35 and 62, and all claims dependent thereon, are patentable in light of the prior art cited and looks forward to favorable reconsideration.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner

believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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